

Claims

1. A depth of interaction detector with uniform pulse-height, which comprises a multi-layer scintillator obtained by coupling at least two scintillator cells on a plane and then stacking the planar coupled scintillator cells, in layers, up to at least two stages and a light-receiving element connected to the bottom face of each scintillator cell of this multi-layer scintillator, wherein the detector is provided with a means for discriminating the position of a scintillator cell, which receives radiant rays and emits light rays and a means for making, uniform, the quantity of the light emitted from each scintillator cell and received by the light-receiving element.
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2. The depth of interaction detector with uniform pulse-height as set forth in claim 1, wherein the multi-layer scintillator is one obtained by coupling a plurality of scintillator cells arranged in a matrix of 2 to 3 columns and 2 to 3 rows on a plane and then stacking the resulting planar coupled scintillator cells, in layers, up to 3 to 5 stages.
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3. The depth of interaction detector with uniform pulse-height as set forth in claim 1, wherein the multi-layer scintillator is one obtained by coupling 4 scintillator cells arranged in a matrix of 2 columns and 2 rows on a plane and then stacking the resulting planar coupled scintillator cells in layers of four stages.
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4. The depth of interaction detector with uniform pulse-height as set forth in any one of claims 1 to 3, wherein the means for discriminating the position of the scintillator cell, which absorbs radiant rays and emits light rays is one for discriminating or identifying the pulse shape of the light emitted from scintillator layers in the proximity to one another.
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5. The depth of interaction detector with uniform pulse-height as set forth in claim 4, wherein the means for discriminating the pulse shape of the light emitted from scintillator layers in the proximity to one another is one

which makes use of the difference in the attenuation-time coefficient for the emitted light.

6. The depth of interaction detector with uniform pulse-height as set forth in claim 5, wherein the difference in the attenuation-time coefficient is not less than 5 ns.

7. The depth of interaction detector with uniform pulse-height as set forth in claim 6, wherein the scintillator is a cerium-doped Gd_2SiO_5 single crystal.

8. The depth of interaction detector with uniform pulse-height as set forth in any one of claims 1 to 7, wherein the means for making, uniform, the quantity of the light emitted from each scintillator cell and received by the light-receiving element is the roughened surfaces of the scintillator cells in the scintillator layer in the proximity to the uppermost scintillator layer; the mirror-finished surfaces of the scintillator cells in a scintillator layer other than those in the proximity to the uppermost scintillator layer; the disposition of a light-reflecting material between the scintillator cells in a scintillator layer other than the uppermost scintillator layer and the scintillator layers in the proximity thereto; and the disposition of a light-reflecting material on the outer surfaces of a scintillator cell free of any neighboring scintillator cell.

9. The depth of interaction detector with uniform pulse-height as set forth in any one of claims 1 to 8, wherein the boundaries between each pair of neighboring scintillator layers and the boundaries between each light-receiving element and the corresponding neighboring scintillator layers are filled with a light-permeable material transparent to the light rays emitted from the scintillator cell.

10. The depth of interaction detector with uniform pulse-height as set forth in any one of claims 1 to 9, wherein it comprises a multi-layer

scintillator obtained by coupling 4 scintillator cells arranged in a matrix of 2 columns and 2 rows on a plane and then stacking the resulting planar coupled scintillator cells in layers of four stages and a light-receiving element connected to the bottom face of each scintillator cell of this multi-layer scintillator, wherein the scintillator is a cerium-doped Gd_2SiO_5 single crystal; wherein the doses of the cerium in the cerium-doped first and third scintillator layers are higher than those observed in the cerium-doped second and fourth scintillator layers and wherein the difference between the attenuation-time coefficients of these two kinds of scintillator layers is not less than 10 ns.

11. The depth of interaction detector with uniform pulse-height as set forth in claim 10, wherein the surfaces of the scintillator cells in the first, second and fourth scintillator layers are mirror-finished; the surface of the scintillator cells in the third scintillator layer are surface-roughened; light-reflecting materials are interposed between the scintillator cells in the first and second scintillator layers and on the outer surfaces of the scintillator cells; the boundaries between each neighboring scintillator layers and the boundaries between the light-receiving elements and the first scintillator layer are filled with silicone oil; the boundaries between the scintillator cells in the third and fourth scintillator layers are filled with air; the scintillator cells in the first and third scintillator layers are Gd_2SiO_5 single crystals each doped with 1.5 mole% of cerium; and the scintillator cells in the second and fourth scintillator layers are Gd_2SiO_5 single crystals each doped with 0.5 mole% of cerium.